ABRIDGED

INTEREST TABLES,

—BY—

M. L. EDMUNDS.

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INTRODUCTION.

The importance of a method that can be readily applied in the calculation of interest, has led to the exercise of considerable ingenuity in order to discover the shortest and simplest rule in practice. The object of this work, which gives the method used by the author in the preparation of his Complete Interest Tables, is to present a method for computing interest, not only brief, but one that will give correct interest; this being a feature in which most methods are deficient in consequence of reckoning time incorrectly. It may be readily seen that an error arises in the use of all methods for computing interest, whereby the month is reckoned at 30 days and consequently the year at 360 days; hence the objection to the favorite 6 per cent. method, also to various other methods which by reckoning 360 days to the year, give for fractional parts of a year, an amount of interest exceeding the exact interest by the same ratio that 365 days exceed 360 days.

There being 365 days in a year, it is impossible to divide the year into months

each containing an equal number of entire days, and therefore impracticable to reckon time in months. This difficulty may be obviated by using methods whereby interest is calculated for the number of days. Indeed, the only correct methods are those by which interest, for periods of time less than one year, is calculated for the exact number of days, and the most practical method is that which by the most natural process, with the least amount of labor, will give exact interest.

Exact interest, obtained by reckoning 365 days to the year, is growing in favor with bankers and other business men, is the method of interest used by the United States Government, and by foreign correspondents, and is the method of interest becoming the most popular and which ultimately is destined to be in universal use.

In solving problems in simple interest, the primary object is to find the interest on a given principal for a given time and rate. That method which is the most natural and which is the most simple in principle, is to find the interest for one year by multiplying the principal by the rate, and then multi-

plying this interest by the time in years. The objection to this method, heretofore, has been in the difficulty of multiplying by the time, which given in months and days, has been considered incapable of being reduced to convenient fractional parts of a year. The method by abbreviated multiplication of decimals, presented in this work, enables us to follow the natural process, while at the same time it gives us the shortest method possible for calculating exact interest.

The subject may be conveniently treated under three cases, viz: to find the time; to express the time in years; and, to find the required interest. To this is appended a general rule together with a variety of problems illustrating the method of obtaining, and multiplying by, the decimal years.

The amount of table work, not aggregating one-half page, all of which should be thoroughly committed to memory, forms a prominent feature of this method, there being so little required to be memorized in order to compute time readily or to reduce days to decimal years. It will also be observed that if such periods of time, as

are in frequent use, have their respective decimal years memorized, the computation of interest for these periods becomes susceptible of easy mental calculation—a desideratum yet unattained by any other method for calculating exact interest.

It is not within the author's province, in a work of this nature, to present a treatise on the fundamental rules of arithmetic; therefore, those who are desirous of perfecting themselves in the method for computing interest herein given, should first become familiar with the fundamental operations, also with decimals and with circulates, subjects treated exhaustively in all higher arithmetics.

Having prosecuted the work with the view of facilitating the calculation of interest, the author now submits his method to the candor and discernment of those whose avocations demand a practical treatise on this important subject, and leaves whatever merit the method deserves to the decision of those competent to judge.

M. L. Edmunds.

ABRIDGED INTEREST TABLES.

TO FIND THE TIME.

In order to compute time readily, the following table, which gives the number of days in the year previous to the first day of each month, should be committed to memory:

January..... 0	May.....120	September....243
February....31	June.....151	October.....273
March.....59	July.....181	November.....304
April.....90	August..212	December.....334

To find the day of the year of any date, add the day of the month to the number in the table corresponding to the month, the sum will give the day of the year. E. G.—The number in the table corresponding to March is 59, which is the number of days in the year previous to March 1st. The day of the year corresponding to March 10th is found by taking the sum of 59 and 10 which is 69; hence March 10th is found to be the 69th day of the year.

To find the difference of time between two dates in the same year, subtract the day of the year of the former date from the day of the year of the latter date, the remainder will be equal to the difference of time

in days between the two dates. E. G.—By the table, February 12th is found to be the 43d day of the year, and July 20th the 201st day of the year. The difference of time in days from February 12th to July 20th is found by taking the difference between 43 and 201 which is 158.

If the dates are in consecutive years, and the time less than one year, subtract the day of the year of the former date from 365 and add the remainder to the day of the year of the latter date. E. G.—November 15th is the 319th day of the year. The number of days from November 15th to the close of the year is equal to the difference between 319 and 365 which is 46. February 10th is the 41st day of the year; hence the number of days from November 15th to February 10th is equal to the sum of 46 and 41, which is 87.

If the time exceeds one year, determine the number of entire years, and then reckon the exact number of days remaining, by the foregoing rules.

In passing over February in leap year, add 1 to the number of days found by the table.

TO EXPRESS THE TIME IN YEARS.

Since each day is $\frac{1}{365}$ of a year, any number of days will be equal to as many 365ths of a year as there are days in the given time, and the fractional part of a year thus represented may be reduced to a decimal year by annexing ciphers to the number of days and dividing by 365. E. G.—97 days equal $\frac{97}{365}$ of a year; and 97.0̇ divided by 365 equals .2̇65753424̇; hence 97 days equals .2̇65753424̇ of a year.

To facilitate the process of reducing days to decimal years, commit to memory the following table:

365 × 1= 365	365 × 4=1460	365 × 7=2555
365 × 2= 730	365 × 5=1825	365 × 8=2920
365 × 3=1095	365 × 6=2190	365 × 9=3285

THE DECIMAL YEAR.—In reducing days to decimal years we annex ciphers to the number of days and divide by 365. The division will in most cases result in decimals which do not terminate but when expanded sufficiently far, will result in a series of figures called the repetend which will constantly repeat in the same order. Such decimals are called circulating decimals and those repetends in which the terms of the first half are respectively equal to 9 minus the corresponding terms of the second half are called complementary repetends.

Let the reduction of 97.0̇ ÷ 365 be continued five decimal places and we have 2, the finite or non-repeating part of the decimal, and 6575 the first half

of the repetend. Subtracting the terms of the first half of the repetend respectively from 9 gives 3424, the terms of the last half, and we have the mixed circulate .265753424 containing the complementary repetend 65753424. It is therefore evident that in making such reduction or in memorizing a decimal year it is unnecessary to continue the reduction or the memorizing further than is required to determine the first half of the repetend, since any number of terms following may be determined from the first half of the repeating part.

When the number of days is 73 or a multiple of 73 the corresponding decimal year terminates with tenths. When the number of days is 5 or a multiple of 5 the corresponding decimal year results in a circulate whose repetend begins with the first term of the decimal. All other decimal years are circulates whose repetends begin with the second term of the decimal. The repetend of any circulating decimal year is complementary and consists of eight terms and may be indicated by placing a period over the first and the last figures.

As the number of decimal places ordinarily required is from three to five the above principles of circulates are employed to expedite the process of reduction only when interest is required on extremely large amounts or when decimals are to be memorized.

TO FIND THE INTEREST.

Multiplying the principal by the rate gives the interest for one year, and this interest multiplied by the time in years gives the required interest.

The process of multiplying by the time when expressed in decimal years is performed by multiplying the interest for one year by the number of entire years, and the interest for each decimal division of one year's interest by the corresponding decimal part of the given time.

EXAMPLE.—Required the interest of $3987, for 2 years and 316 days, at 5 per cent.

OPERATION.

$3987=Principal.
.05=Rate.

199.35=Interest for 1 year.
57568.2=Time expressed decimally.

398.70=Interest for 2 years.
159.48=Interest for 8 tenths of a year.
11.96=Interest for 6 hundredths of a year.
1.00=Interest for 5 thousandths of a year.
.14=Interest for 7 ten-thousandths of a year.
1=Interest for 5 hundred-thousandths of a year.

$571.29=Required interest.

SOLUTION.—Multiplying the principal $3987, by the rate .05, gives $199.35 inter-

est for one year, and this interest divided by 10, 100, 1000, etc., which is effected by moving the decimal point respectively, one, two, three, etc., places to the left will give $19.93+, $1.99+, $0.19+, etc., which equal the interest respectively for one tenth of a year, 1 hundredth of a year, 1 thousandth of a year, etc. By writing the terms of the decimal years, which are years, tenths of a year, hundredths of a year, thousandths of a year, etc., respectively under the right hand terms of the interest for one year, 1 tenth of a year, 1 hundredth of a year, 1 thousandth of a year, etc., we have the terms of the decimal years written in an inverted order, each properly written under the interest which must be multiplied by it. This arrangement enables us to contract each partial product to the required denomination, and to reject all partial products of a lower denomination than required in the entire product. Multiply the interest for 1 year ($199.35), 1 tenth of a year ($19.93+), 1 hundredth of a year ($1.99+), 1 thousandth of a year ($0.19+), etc., respectively by the number of entire years (2), tenths of a year (8), hundredths

of a year (6), thousandths of a year (5), etc., increasing each partial product by as many units as would have been carried to it from the product of the rejected terms, and 1 more when the second term towards the right in the product of the rejected terms is 5 or more than 5; and place the right hand terms of these partial products in the same column. The sum of these partial products will be the required interest.

The rejected terms are the denominations lower than cents in the interest for 1 year, 1 tenth of a year, 1 hundredth of a year, 1 thousandth of a year, etc.

The terms of the decimal years must be extended one place farther to the left than the number expressing the interest for one year, in order to obtain the last partial product which is equal only to the number of units that would have been carried from the product of the rejected terms.

GENERAL RULE.

I. Multiply the principal by the rate to find the interest for 1 year.

II. Write the number of entire years, when not exceeding 9, under that part of the interest for 1 year, generally cents, which is of the lowest denomination in the required interest. If the time is less than 1 year place a cipher for the vacant term of years. Annex ciphers to the number of days and divide by 365 and write the quotient figures which will be tenths of a year, hundredths of a year, thousandths of a year, etc., in a reverse order at the left of the number of years, extending the terms of the decimal years, when interminate, one place farther to the left than the terms of the number expressing the interest for 1 year. If the number of entire years exceed 9, and there are decimal years remaining, write the decimal years and the number of entire years as separate multipliers.

III. Regard the interest for 1 year divided by 10, 100, 1000, etc., which will give the interest respectively for 1 tenth of a year, 1 hundredth of a year, 1 thousandth of a year, etc.

IV. Multiply the interest for 1 year, 1 tenth of a year, 1 hundredth of a year, 1 thousandth of a year, etc., respectively by

the number of entire years, tenths of a year, hundredths of a year, thousandths of a year, etc., increasing each partial product by as many units as would have been carried to it from the product of the rejected terms, and 1 more when the second term toward the right in the product of the rejected terms is 5 or more than 5; and place the right hand terms of these partial products in the same column.

V. Add these partial products; the sum will be the required interest.

NOTES. 1.—In reducing days to decimal years, when solving problems, place the number of days at the right of years with the divisor 365 at the right of days. Determine whether the first quotient figure is tenths of a year or hundredths of a year by observing whether one or two ciphers must be annexed to the number of days in order to be divisible by 365. If more ciphers are required they need not necessarily be annexed to the number of days as the work may be made more concise by annexing them to the remainders only. The operation may be still further abbreviated by not writing the divisor 365 or the products of 365 by the quotient figures, since the work can be carried on mentally as in short division.

2. Common interest may be calculated by the same process as exact interest; but in reducing the days to decimal years divide by 360 instead of 365. In this reduction the decimal, when interminate, results in a circulate whose repetend consisting of but one figure is readily found by observing when a quotient figure begins to repeat.

ILLUSTRATIVE EXAMPLES.

1. Required the interest of $225, for 2 years and 40 days, at 8 per cent.

OPERATION.

$225
.08

18.00
5901.2 | 40.0(365
365

36.00
1.80
16
1

2150

$37.97 Ans.

2. Required the interest of $256.75, for 93 days, at 5 per cent.

OPERATION.

$256.75
.05

12.8375
7452.0 | 93.0
2000

2.57
.64
5
1

1750
2900

$3.27 Ans.

3. Required the interest of $400, for 10 years and 22 days, at 12 per cent.

OPERATION.

$400
.12

48.00
2060.0 | 22.00
10 | 1000

2.88
1
480.00

$482.89 Ans.

4. Required the interest of $60.25, for 5 years and 73 days, at 7 per cent.

OPERATION.

$60.25
.07

4.2175
2.5 | 73.0

21.09
.84

$21.93 Ans.